GEOLOGY FOR PLANNING IN NORTHEASTERN ILLINOIS

VII. GEOLOGY FOR PLANNING IN DU PAGE COUNTY

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INTRODUCTION

DuPage County has a total population of approximately 492,000 and a land area of about 340 square miles (880 km^2). The eastern boundary of the county is only 10 miles (16 km) west of downtown Chicago. The eastern portion of the county is highly developed, especially Addison, York, Milton, and Downers Grove Townships. The western portion is largely rural.

Purpose and Format

An understanding of the physical environment is fundamental to effective regional land-use planning. Therefore, a major purpose of this report is to describe and map the distribution of geologic materials which man utilizes as resources, upon which he builds his structures, and into which he disposes of his domestic and industrial wastes. The potential for pollution of ground-water and surface-water resources in DuPage County is intensified by the volume and variety of waste products generated. Thus a second major purpose of this report is to relate geologic conditions to the potential for contamination of either ground-water or surface-water resources due to various waste disposal and land treatment practices.

The format of this report on DuPage County is similar to the reports on other counties in the six-county area. The geologic framework of the area, the project scope, funding, mapping criteria, and mapping procedures are described in volume 1.

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GEOLOGY

The topography, drainage and unconsolidated deposits in DuPage County are the result of the action of glacial ice and running water. Underlying these deposits is layered bedrock, mainly dolomite of Silurian age with a small amount of the Maquoketa Shale Group in the north central part of the county. The general stratigraphy and age relationships of both the glacial deposits and the bedrock are shown in Figures 1 and 2 in volume 1. Detailed descriptions of bedrock geology can be found in Buschbach (1964) and Willman (1973), while a summary of the bedrock geology can be found in Willman (1971). The ground-water resources of DuPage County and a general discussion of the geology of the county are in a report by Zeizel et al. (1962a).

The thickness of the glacial deposits over bedrock varies from 0 to slightly over 200 feet (60 meters). The bedrock outcrops south of Naperville, near Elmhurst, and along the Des Plaines River. The thickest glacial deposits occur where the West Chicago and Valparaiso Moraines cross buried bedrock valleys.

Geologic Materials to a Depth of 20 Feet

Geologic materials are mapped to a depth of 20 feet (6 meters) on plate 1. The legend on plate 1 lists the surficial deposits in stratigraphic order with the oldest at the bottom and the youngest at the top. For convenience, Table 1 in the text of volume 1 lists the unconsolidated deposits in alphabetical order. In this report, the deposits are described in groupings of similar materials: till, glacial sand and gravel, glacial lake and wind-blown deposits, and recent deposits. Data on the physical properties of major mapped units are given in Table 1.

Data in the form of driller's logs and samples from water well borings were plentiful in the eastern half of DuPage County where there are many incorporated areas. However, in the more rural western half, data were sparse and unevenly distributed. Detailed soils mapping of DuPage County by the U.S.D.A. Soil Conservation Service were also utilized in mapping the geologic materials.

Till

In DuPage County, till comprises about 75 percent of the geologic materials mapped within 20 feet (6 meters) of the surface.

Wedron Formation

All of the tills present in DuPage County belong to the Wedron Formation. Some of the tills are deeply buried below younger tills for almost the entire extent of the county, yet may come to the surface within ten miles west of the Kane County border.

Tiskilwa Till Member (wt). The Tiskilwa Till is the oldest till present in DuPage County and occurs only in the subsurface, always at a depth greater than 20 feet (6 meters) below the surface. It occurs in the northwestern part of the county and is up to 36 feet (11 meters) thick and buried by about the same amount

TABLE 1

Physical and Mineralogical Properties of
Geologic Units Mapped in DuPage County

Units		Data									
		N	qu	w	δd	Sd	St	Cl	M	I	C-K
Peyton Colluvium (py)	$\bar{X}$	-	0.26	24.5	101.6	11	54	35	-	-	-
Accretion-gley (ag)	n	-	5	5	5	3	3	3	-	-	-
	R	-	0.1-0.4	21.8-25.2	101-115	5-16	43-66	23-42	-	-	-
Grayslake Peat (gl)	$\bar{X}$	-	0.1	89	44.7	5	50	45	-	-	-
	n	-	3	9	3	4	4	4	-	-	-
	R	-	0.1-0.2	34-169	30-63	0-16	48-54	36-51	-	-	-
Equality Formation	$\bar{X}$	12	1.7	25.1	111.0	6	54	40	-	-	-
Carmi Member (ec)	n	13	16	24	7	24	24	24	-	-	-
	R	5-27	0.4-6.6	15.4-33.8	94-131	1-13	37-81	13-52	-	-	-
Wedron Formation	$\bar{X}$	22	3.5	17.7	115	12	42	46	5	76	19
Wadsworth Till	n	130	131	155	34	156	156	156	47	47	47
Member (ww)	R	7-69	1.1-9.7	10.8-27.0	105-125	1-23	22-89	9-77	3-8	70-81	14-23
Yorkville Till	$\bar{X}$	20	3.6	17	117	9	48	43	3	78	19
Member (wy)	n	32	474	887	556	608	608	608	78	78	78
	R	9-45	1-10	10-35	92-138	2-22	33-65	28-55	2-5	73-81	16-24

Explanation of Symbols:

$\bar{X}$ = mean
n = number of tests
R = range of data: low value - high value
N = number of blows per foot (Standard Penetration Test)
qu = unconfined compressive strength in tons per square foot
w = natural moisture content in percent
δd = dry density in pounds per cubic foot
Sd
St } = percent of sand, silt and clay, respectively, in < 2mm fraction of sample
Cl
M = percent montmorillonite and expandables in clay fraction
I = percent illite in clay fraction
C-K = percent chlorite plus kaolinite in clay fraction

Data for several mapped units are not available for DuPage County.

of drift. It is frequently underlain by a basal gravel 5 to 15 feet (1.5 to 4.5 meters) thick; where the basal gravel is absent, it rests directly on the bedrock. The Tiskilwa Till is a reddish-brown to reddish-gray sandy silt and is very uniform in composition.

Malden Till Member (wm). The Malden Till is a yellowish-gray to gray-tan silty, locally sandy till with discontinuous beds of sand and gravel. In DuPage County is occurs only in the subsurface, and is shallower than 20 feet (6 meters) in the southwestern portion. Its northern limit of occurrence appears to be at about the northern county border. It is often locally absent and is usually overlain by the fairly continuous Malden Outwash (wm-o). Thickness of the Malden Till ranges from 0 to 36 feet (11 meters).

Yorkville Till Member (wy). The Yorkville Till is present within 20 feet (6 meters) of the surface along the western edge of the county. The thickness reaches a maximum of about 120 feet (36 meters) in DuPage County on the backslope of the Minooka Moraine on the western edge of the county. The Yorkville Till is a grayish-brown to brownish-gray silty clay to clay loam till. In the northern part of the county the Yorkville Till is overlain by the Haeger Till and/or the Haeger Outwash which thin to the south until the Wadsworth Till Member rests directly on the Yorkville. The Wadsworth Till and the Yorkville Till are very similar in appearance and composition and thus are very difficult to distinguish in the subsurface even with mineralogical data.

Haeger Till Member (wh). The Haeger Till occurs as a thin, patchy deposit of yellowish-brown, silty, sandy loam. Where it occurs, it overlies a fairly thick and extensive proglacial outwash, mapped as wh-o. The Haeger Till is similar to its associated outwash and in the subsurface it is often reported as sand and gravel. Its western margin is the West Chicago Moraine, where it is characterized by hummocky stagnation features comprised of hills and ridges of outwash sand

and gravel and poorly drained areas of waterlaid materials, modern accretion gleys and peat. In DuPage County the Haeger Till rarely exceeds 10 feet (3 meters) in thickness.

Wadsworth Till Member (ww). The Wadsworth Till is a very clayey, uniform, gray till. It is the youngest till member of the Woodfordian Substage in Illinois and thus is the only surficial till present east of the West Chicago Moraine in DuPage County. The Wadsworth is the most extensive geologic unit in the county and ranges from 0 to about 100 feet (30 meters) thick in the Valparaiso Moraine. In the northern part of the county it overlies the Haeger Outwash, at the West Chicago Moraine, but to the south it is directly over the Yorkville Till.

Glacial Sand and Gravel

Much of the sand and gravel deposits of DuPage County can be stratigraphically and mineralogically associated with given till units. These include the extensive Malden Outwash (wm-o) and the thick Haeger Outwash (wh-o).

The Haeger Outwash is as much as 100 feet (30 meters) thick locally in the West Chicago Moraine, but averages about 40 feet (12 meters) thick. To the west of the western margin of the Haeger Till, the West Chicago Moraine, the surficial outwash becomes a member of the Henry Formation. Arbitrarily, a vertical "cutoff" is made in this area in the subsurface between outwash mapped as Henry Formation and as Haeger Outwash Member. The eastern margin of the Haeger Outwash appears to be just west of the West Branch of the DuPage River where the Haeger abruptly thins. The southern limit is near the City of West Chicago.

The Malden Outwash is a very continuous blanket underlying the Yorkville Till and overlying the Malden Till if present. Where it fills in bedrock lows, the Malden Outwash is up to 60 feet (18 meters) thick.

Other bodies of outwash are present--mostly local lenses of sand and

gravel 10 feet (3 meters) thick or less. There are also small areas of surface outwash present on the Wadsworth Till plain.

Henry Formation

Surface outwash deposits (excluding the Haeger Outwash in the West Chicago Moraine) are assigned to one of three members of the Henry Formation differentiated on the bases of lithology and mechanism of deposition.

Valley Train Deposits (Mackinaw Member, hm). The Mackinaw Member consists of generally clean, medium textured sand and gravel that was deposited by meltwater along the Des Plaines River, the East Branch of the DuPage River, Salt Creek, and Poplar Creek. In many cases the Mackinaw Member grades into the Batavia Member, and without detailed information they are difficult to distinguish.

Outwash Plains (Batavia Member, hb). The Batavia Member is composed of clean sands and gravels deposited by meltwater on broad plains in front of glaciers. The outwash may be coarse sand and gravel as in the Haeger Outwash, or may be sandy as in the outwash associated with the Wadsworth Till Member.

Kames and Eskers (Wasco Member, hw). The Wasco Member consists of poorly sorted sand and gravel that occurs in hills, mounds, and knobs, deposited by meltwaters cascading either off the ice front or into holes, crevasses, or tunnels in the ice. The Wasco Member occurs in the southern part of DuPage County south of Naperville, near Argonne National Laboratory, and between Naperville and Lisle; and in the northern part it occurs along Spring Brook near Itasca.

Glacial Lake and Wind-Blown Sediments

Glacial lake deposits are fairly common in DuPage County. There are extensive deposits along the front of the West Chicago Moraine from the Cook County border on the north to Naperville, and scattered glacial lake deposits

south of Roselle and south of Wheaton. These deposits are quiet water lacustrine silts and clays with minor fine sands and are mapped as the Carmi Member of the Equality Formation (ec). They are yellowish-gray to grayish-brown, faintly bedded to massive, with a uniform texture; they may contain some organics. The thickness of the Carmi Member occasionally exceeds 20 feet (6 meters), but commonly the thickness is about 10 feet (3 meters).

Wind-blown loess deposits, as described in volume 1, are found as a thin veneer over most of DuPage County. Because these deposits are generally less than 3 feet (.9 meter) thick, they were not mapped in DuPage County.

Recent Deposits

In addition to glacial sediments, recent geologic surficial materials are present in DuPage County. Alluvial deposits, mapped collectively as Cahokia Alluvium (c), may contain some organic material, silt, clay, sand, and sometimes gravel. It is found along many streams in DuPage County. Recent sediments are also found in shallow, poorly-drained depressions and along stream valleys where they accumulated as a result of slopewash and other downslope gravity movements. Such modern deposits are referred to either as accretion gley (ag) in isolated depressions, or, where they may grade into predominately organic peat or muck deposits, as Grayslake Peat (gl); where they occur as slopewash along valley walls, they are referred to as Peyton Colluvium (py).

Terrains

The landscape in DuPage County can be subdivided into three basic terrains: uplands, plains, and lowlands. Plate 2 is a terrain map for the county and shows areas of plains and lowlands, listed as B and C, respectively. Regionally extensive uplands are absent in DuPage County. There are a few small upland areas with rolling topography where slopes may locally exceed 7 percent. Because these areas

are small, they are not significant, and are included in plate 2 with areas mapped as plains. Flat to gently rolling plains comprise most of the surface in DuPage County.

The land surface is highest in the northwestern portion of the county, where the upland surface attains an elevation of 830 feet above sea level. Regionally, the land surface slopes gradually toward the southeast, and the lowest elevations in the county are approximately 585 feet above sea level in the Des Plaines River Valley. Maximum relief for the county is about 245 feet (75 meters).

The lowlands essentially are along watercourses and include the west and east branches of the DuPage River and the Des Plaines River, which is the southeastern boundary of the county. In general, all of the lowlands are relatively narrow with few areas approaching a mile in width. The lowlands are mainly underlain by medium-to-coarse textured water-laid sediments. Although the lowlands are mostly flat, with very low gradients toward the south, locally slopes as steep as 7 percent or more occur.

NATURAL AND ARTIFICIAL RECHARGE

Those areas of DuPage County where there is potential regional and local natural recharge are plains underlain by relatively thick and extensive sand and gravel at a shallow depth. These areas of high hydraulic conductivity (permeability) have potential for ground-water development and may be areas where natural recharge may be significant and artificial recharge most practical. Areas of higher elevation underlain by materials of high conductivity are considered to be the principal areas for natural recharge, mainly from rainfall, though slope characteristics and resulting runoff may reduce the overall effectiveness of these areas regionally. The artificial drainage of the landscape in urbanized areas of the county further

limits the amount of rainfall which is available to move downward into the ground-water reservoir.

It is probable that portions of the upland and plain terrains in northern DuPage County and the areas mapped as plains in the west-central and southwestern portions of the county may be providing some recharge to the shallow aquifer system. Although the predominant geologic materials covering most of DuPage County are the silty clay Wadsworth and Yorkville Till or other fine-textured deposits, upland and plain areas underlain by these materials are still capable of contributing significantly to natural recharge, at least locally, in DuPage County. In part, this recharge may be facilitated by the presence of a relatively permeable surface soil and fractures in the upper portion of the till.

Although significant ground-water discharge is generally to the lowland areas, there is also good indication that ground-water flow enters Lake Michigan (Cartwright et al., 1976). Although there is hydrogeologic evidence that the upland terrains of Kane and McHenry Counties may contribute most to natural recharge regionally, some recharge probably originates in the uplands and plains adjacent to the lowland areas of DuPage County. It is likely that natural ground-water flow is generally eastward with some discharge into the Des Plaines and Chicago River systems.

DRAINAGE CONDITIONS

Plate 2 shows large areas of poorly-drained soils throughout DuPage County. These poorly-drained soils which were interpreted directly from recent SCS soils mapping are most extensive in the western half of the county. The poorly-drained areas occur along drainageways, where they reflect local ground-water discharge; in morainic areas; where they reflect localized depressions resulting from the lack of integrated drainageways; and in intermorainic areas, where they reflect localized

lacustrine deposits. Poorly drained conditions in DuPage County are aggravated by the widespread occurrence of fine-grained surficial materials (ww, wy, ec, ag, py, gl, c), which retard infiltration, and by the many relatively impermeable surfaces in urbanized areas, which increase run-off.

INTERPRETATION FOR PLANNING

Waste Disposal and Pollution Potential

Five waste disposal maps are presented for DuPage County which evaluate conditions relative to:

(1) land burial of wastes (plate 4a)

(2) surface spreading of wastes (plate 4b)

(3) waste disposal by septic systems (plate 4c)

(4) application of fertilizers and soil additives (plate 4d)

(5) application of herbicides and insecticides (plate 4e).

These maps only indicate a probability of finding suitable or unsuitable sites within DuPage County, and they cannot be considered a replacement for individual site evaluation. A detailed discussion of the factors involved and limitations in the mapping is presented in volume 1 of this series.

Land Burial of Wastes (including sanitary landfills)

This map (plate 4a) differentiates areas for the burial of all types of waste products in the ground. The state of the waste product is not distinguished; that is, whether it is solid, semisolid, or liquid. The map is for the burial of both domestic refuse and industrial chemical waste, some of which may be toxic. Areas A through E are listed in ascending order of their capacity to provide protection from pollution of both ground water and surface waters. The basic assumptions are: 1) burial in a trench 20 feet deep, and 2) contact with ground water.

In small portions of DuPage County along major valleys the dolomite bedrock aquifer is within 20 feet (6 meters) of land surface (area A). The dolomite bedrock aquifer occurs within 50 feet (16 meters) of land surface (area C) adjacent to major drainageways and in an extensive region of the southwestern portion of the county.

Areas where sand and gravel aquifers are present within 20 feet (6 meters) of land surface (area B) were mapped from the geologic materials map. The significance of some of these areas as shallow aquifers is questionable. In highly urbanized areas of the county, the water present in surficial sands and gravels may present severe water quality problems. Surficial sands and gravels present in the large region mapped as area B in the southwestern part of the county may not be important for large supplies of ground water. However, the presence of shallow outwash and the common occurrence of dolomite bedrock within 25 to 50 feet (8 to 16 meters) of land surface are unfavorable factors to location of sanitary landfills in this area.

Areas thought to be underlain by sand and gravel aquifers within 50 feet (16 meters) of land surface (area D) were interpreted for DuPage County from maps of sand and gravel aquifers published in Zeizel et al. (1962a).

Most of eastern DuPage County is mapped as area E, which includes those areas where impermeable materials (mainly Wadsworth Till) are generally greater than 50 feet (16 meters) thick. Many of these areas are relatively flat and poorly drained so that provisions have to be made to prevent surface drainage into land burial operations. Surficial sand and gravel may be locally present in areas mapped as E; such areas generally require measures to seal off the permeable surficial materials from the landfill operation.

Areas that correspond to the categories described above but are poorly drained are mapped B', C', D' and E', respectively. The poorly drained areas were generalized from the detailed soils maps.

Any prospective site for land burial of waste must be individually evaluated. The development of specific sites is often a sensitive matter in DuPage County and may be based on many factors other than the general suitability of the earth materials. In some cases, unsuitable sites may be engineered to conform to state requirements for licensing.

Surface Spreading of Wastes

Plate 4b differentiates areas where there may be pollution problems resulting from the spreading of wastes on the land surface or in the top soil. It is to be used primarily for the placement of industrial and sewage wastes, by any method, on the land surface. In DuPage County, as in other counties in this study, the factors considered in mapping include depth to sand and gravel aquifers or dolomite bedrock aquifers, terrain, drainage conditions, and soil characteristics - particularly hydraulic conductivity.

Areas which have the most severe limitations for surface spreading of wastes are those areas where bedrock is within 5 feet (1.6 meters) of ground surface (area A). Shallow dolomite bedrock occurs along the Des Plaines River Valley in the southeastern corner of the county and along the West Branch of the DuPage River in the vicinity of Naperville.

Remaining portions of DuPage County are included either in area B, which is characterized by surficial sands and gravels, or in area C, which is generally characterized by poorly drained lowlands or plains underlain by relatively impermeable surficial materials. Areas mapped as B (surficial sands and gravels) occur mainly along major drainageways. In the northwestern part of the county surficial sand and gravel occurs over broad regions in outwash plains. As discussed under Land Burial of Wastes, many of these surficial sands and gravels probably cannot be considered surficial aquifers. However, since these areas are characterized by

high infiltration rates, they must be differentiated for surface spreading of wastes. Areas mapped as area C mainly include large portions of DuPage County which are underlain by Wadsworth Till (ww). Wadsworth Till is very clayey, has a low hydraulic conductivity, and is frequently characterized by poor drainage. Locally, slopes may exceed 7 percent in morainic areas. Since waste materials either infiltrate very slowly in areas of low relief or tend to run off of steeper slopes, acceptability is the major problem for surface spreading of wastes in areas mapped as C.

There are no areas in DuPage County without limitations for surface spreading of wastes. Thus, as in Lake and Cook Counties, there are no E areas mapped.

Waste Disposal by Septic System

Conditions for waste disposal by septic systems for DuPage County are shown on plate 4c. The major factors in outlining these conditions are potential for pollution of shallow aquifers, drainage characteristics of the materials and terrain characteristics. There are no areas within the county without limitations for septic systems.

Areas with the greatest limitations (area A) are where surficial sands and gravels occur and high infiltration rates may cause rapid movement of pollutants into the shallow ground-water system. These areas occur mainly along the drainage courses and in a broad region of the northwestern part of the county where surficial sand and gravel occurs in outwash plains.

Area B delineates areas where sand and gravel or dolomite bedrock occurs within 20 feet (6 meters) of the surface. The most critical areas are those where septic wastes could move rapidly through sand and gravel directly into the Silurian dolomite (shallow bedrock aquifer). As in area A, the potential for rapid infiltration into the shallow ground-water system or shallow aquifers is high. B areas in

DuPage County occur adjacent to A areas along major drainageways. B areas are also mapped over large regions of the western part of the county where sand and gravel occurs in broad outwash plains overlain by fine-grained deposits.

Areas mapped as C include upland areas with steep slopes along morainic ridges in western DuPage County, lowland areas subject to flooding along drainageways, and discharge areas and poorly drained areas within former lake plains and in depressional areas. In general, acceptance of wastes by earth materials may be a problem in these areas.

Remaining areas in DuPage County are generally underlain by Wadsworth and Yorkville Tills and are mapped as area D. Since these tills have a low hydraulic conductivity, some problems with acceptance of wastes may be a limiting factor, but this restraint is generally less severe than in area C.

Application of Fertilizers and Soil Additives

Plate 4d indicates conditions for application of fertilizers and soil additives in DuPage County. The most severe limitations exist in areas where surficial sands and gravels (area A) and shallow bedrock aquifers (area B) allow excess fertilizers and soil additives to easily enter the ground-water system. The A and B areas are the most critical. In DuPage County, these occur mainly along major drainageways.

Areas mapped as C include those areas where runoff problems or ponding may occur due to materials of low hydraulic conductivity at the surface or because of ground-water discharge. In DuPage County, these include large areas of Wadsworth and Yorkville Tills, poorly drained materials in lowlands, and former lake deposits.

Application of Herbicides and Insecticides

Conditions for application of herbicides and insecticides for DuPage

County are mapped on plate 4e. The limitations for their application are very similar to those for fertilizers and soil additives since both are applied at or near the ground surface and are subject to the same natural processes of precipitation and runoff.

Areas characterized by sand and gravel deposits or dolomite bedrock at the surface or within 20 feet (6 meters) are mapped as area A. Areas where the dolomite bedrock is within 20 feet (6 meters) of land surface occur along major drainageways. Sand and gravel deposits within 20 feet (6 meters) of land surface occur along major drainageways and in extensive outwash plains in the northwestern part of the county.

Remaining areas in DuPage County are included in area B, which includes lowlands or plains underlain by low hydraulic conductivity materials. These materials include Wadsworth and Yorkville Tills, lake deposits, alluvial deposits, and poorly drained depressional materials. Areas mapped as B occur in most of the county.

Land Utilization

Material properties such as texture and bearing capacity and terrain characteristics such as drainage and depth to zone of saturation affect the suitability of land for different uses. Two maps were prepared (plates 5a and 5b) to evaluate both terrain and material characteristics for two specific types of land use in DuPage County - namely, community development and roadway construction. Plates 5a and 5b indicate geologic conditions pertinent to community development and roadway construction. These maps should be used in conjunction with the USGS flood hazard maps and the poorly-drained soils map (plate 3). In plates 5a and 5b, a rigid classification of areas (i.e., good, marginal, poor) was purposely avoided; rather, these interpretive maps should be used as one source of technical input for planning decisions along with other types of non-geologic data. It is assumed that specific construction projects will include an adequate subsurface investigation program.

Construction Conditions for Community Development

Plate 5a indicates construction conditions for community residential development. Major problems in DuPage County associated with land use for community development include poor surface drainage, flooding along major drainageways, and the presence of deposits which have a low bearing capacity such as peat or accretion-gley.

In general, the constraints listed on plate 5a decrease in alphabetical order; however, areas labeled as C or D that are located along drainageways may be subject to infrequent flooding which imposes rather severe restraints for community development. Several small areas in southern DuPage County underlain by shallow bedrock are located along the DuPage and Des Plaines Rivers. Areas of shallow bedrock exhibit very high bearing strength but are extremely difficult to excavate and do not permit septic system construction.

Construction Conditions for Roadways

Plate 5b indicates construction conditions for roadways. In general, roadway planners are concerned with locating areas of poor drainage and low-bearing capacity materials, determining the amount of material to be excavated or replaced in cuts or fills, and locating potential sources of borrow that are close to the proposed construction. Plate 5b generally indicates constraints for roadway construction in decreasing alphabetical order. As detailed in the previous section for community development, major problems relating to construction in DuPage County include areas of poor drainage, areas of low-bearing capacity materials, and areas subject to seasonal flooding. Roadway construction in areas mapped as A may require: (1) special treatment to provide proper support where the surficial material has low strength, (2) construction of embankments to grades above expected flood levels, and (3) construction of structures over waterways. In the remaining areas, cuts and fills may be needed, but the material from cuts should be suitable for common backfill.

NATURAL RESOURCES

Ground-Water Resources

Ground water is the source of all of DuPage County's water supply. This resource is developed primarily from two aquifer systems, one shallow and one deep. The shallow system is comprized of dolomite rocks of Silurian age, dolomite beds in the Maquoketa Formation, and sand and gravel deposits in the glacial drift. The deep aquifers, often referred to as the deep sandstones, are composed of sandstone and dolomite formations of Cambrian and Ordovician ages. A general description of all of these units can be found in volume I of this series.

The Ironton-Galesville Sandstone is the principal water-yielding zone in the deep aquifer and has been heavily pumped for many years. A few wells in the eastern part of the county have penetrated below the Ironton-Galesville into the lower Eau Claire and Mt. Simon Formations but these have subsequently been plugged back into upper Eau Claire, as they yielded water that was too highly mineralized. At present, therefore, production from these deeper formations is very limited. Detailed information of these bedrock aquifers in DuPage County can be found in Suter, et al., 1960; Zeizel, et al., 1962a; and Hughes, et al., 1966.

The Silurian dolomite aquifer is the most heavily developed source of ground water in DuPage County. This aquifer includes rocks of the Niagrian and Alexandrian Series and it occurs below the unconsolidated material throughout most of the county. The thickness of the Silurian dolomite reaches approximately 250 feet (80 meters). Joints, fractures, and solution cavities strongly influence the occurrence, movement and availability of ground water in the Silurian dolomite aquifer. The weathered zone, with solution-enlarged openings in the upper part of the dolomite directly beneath the bedrock surface, is believed to be the major water-yielding zone.

Sand and gravel drift aquifers are present in large areas of DuPage County. The occurrence of surficial sand and gravel aquifers, however, is limited to areas along the major stream valleys and, additionally, to a 10 square-mile area in the northwestern part of the county. The basal sands and gravels, occurring immediately above the bedrock at the base of the drift are the most widespread drift aquifers. These are known to occur over approximately 75 percent of the eastern two-thirds of the county. A major portion of the basal drift aquifers are in hydrologic connection with the shallow dolomite aquifer so that they complement the dolomite and contribute to its productivity. The drift and the Silurian dolomite aquifers are separated from the deep sandstone aquifers by the shales of the Maquoketa Formation.

Since 1950, the population of DuPage County has increased more than 150 percent. During this time the economy of the county shifted from agricultural to urban-manufacturing and the population became heavily concentrated in the urban areas. Consequently, in some of the towns and villages in the county ground-water pumpage has been extremely heavy and has resulted in drastic declines in the yields of some shallow dolomite wells. At present, the total pumpage from the shallow aquifers almost equals the potential yield (Sasman, 1974). (The potential yield is defined as the maximum quantity of ground water that can be pumped from wells without creating critical water levels or exceeding recharge.) Data on the response of the Silurian dolomite aquifer to heavy pumping and data on yields of existing wells has shown that the potential yield of the Silurian dolomite is limited by recharge.

At present, water is being pumped from the deep sandstone aquifer at almost three times the rate considered practical so as not to lower water levels to critical stages or not to exceed recharge (Sasman, 1974). In other words, water is being "mined" from the deep aquifers, as it is being withdrawn in excess of recharge.

Combined pumpage then, from both the shallow and the deep aquifers in DuPage County is now in excess of the natural recharge rate.

DuPage County is thus faced with a challenging problem in trying to meet future water demands. It is clearly evident that the shallow aquifers cannot supply much larger quantities of water than they do at present, and population growth estimates and projections (NIPC, 1968, and Schicht and Moench, 1971) envision that DuPage County may double in population by the year 2000. Additional plans and programs to augment water supply will, of necessity, have to be initiated. Fortunately, there are a number of alternative sources of water and/or methods which can be used to enhance existing supply which are briefly listed below:

1). Continue to mine the sandstone aquifer at accelerated rates as a tremendous quantity of water remains there in storage.

2). Withdraw water from the vast reservoir in the Mt. Simon Sandstone which would be potable after desalinization.

3). Artificially recharge the shallow aquifer to extend its usability.

4). Import water from untapped ground-water sources in central and northwestern Illinois.

5). Import water from Lake Michigan.

Because of the large-scale effort and capital investment needed to develop several of these programs, communities could not individually undertake them. The future development of water supplies for DuPage County, therefore, calls for increasing coordination on a community-wide, county-wide, state-wide and, perhaps, a federal scale to meet the future water supply needs of all citizens and industries within the county.

Sand and Gravel Resources

The sand and gravel resources of DuPage County are summarized in this

report. Information on sand and gravel resources in the Chicago region including DuPage County is published in Ekblaw (1964). An unpublished map on sand and gravel resources in DuPage County was compiled by Zeizel (1962b).

The importance of sand and gravel deposits as mineral resources depends on the thickness and extent of the deposit, its texture, mineralogy, accessibility, and the amount of overburden that may be present. Economically valuable sand and gravel deposits in DuPage County that are accessible, consistent in character, and fairly widespread occur principally in the valley trains of the East and West Branches of the DuPage River (hm) and on the outwash plain in the W½ of T. 40 N., R. 9 E. (hb). Another outwash plain extends from West Chicago to the south-southeast parallel with the West Branch of the DuPage River (T. 39 N., R. 9 E.). In these areas, the sands and gravels are generally well sorted, evenly bedded, and medium to coarse-textured. Texture usually becomes finer with depth, grading to clean sand at the base of the deposits so that the quality of the material is more consistent in a lateral direction than with depth. In the valley bottoms, the deposits occur beneath a thin cover that is easily stripped. Along the valley walls and in the upland outwash plain deposits in the northwestern corner of the county, finer-textured cover materials generally thicken in the direction of higher elevations.

Besides the valley train and outwash plain sands and gravels, several ice-contact deposits (hw), usually in the form of hills and ridges, produce, or have produced, sand and gravel in DuPage County. Their occurrence is sporadic and they are not as desirable a mineral resource as outwash deposits, as they are more variable in texture and more unevenly bedded than the outwash plain and valley train sands and gravels. Ice-contact deposits also may have limited accessibility because cover conditions may be highly variable. However, there are large ice-contact sand

and gravel deposits present south of Churchill Woods (Section 12, T. 39 N., R. 10 E.) and south of Roselle in a band that extends eastward to Itasca (T. 40 N., R. 10 E. and R. 11 E.), and these have been utilized as mineral resources.

In 1971, DuPage County ranked fifth among all counties in Illinois in the production of common gravel and 16th in the production of common sand (Busch, 1973). Production figures for 1973 were withheld to avoid divulging individual company data (Malhotra, 1975), but six companies are operating nine pits within the county (Illinois Department of Transportation, 1976), as follows:

1). Elmhurst-Chicago Stone Company
- Bartlett Pit — NW¼ Sec. 5, T. 40 N., R. 9 E.
- Warrenville Pit — SE¼ Sec. 35, T. 39 N., R. 9 E.
- Winfield Pit — SE¼ Sec. 1, T. 39 N., R. 9 E.

2). River Dell Gravel
- Cloverdale Pit — NW¼ Sec. 23, T. 40 N., R. 9 E.
- Glendale Heights — NE¼ Sec. 26, T. 40 N., R. 10 E.

3). Ajax Sand and Gravel
- Bloomingdale Pit — NE¼ Sec. 14, T. 40 N., R. 10 E.

4). Material Service
- Bloomingdale Pit — SE¼ Sec. 7, T. 40 N., R. 10 E.

5). Sirek, Ted
- Naperville Pit — NE¼ Sec. 11, T. 38 N., R. 9 E.

6). East Riverdale Gravel
- Cloverdale Pit — NW¼ Sec. 23, T. 40 N., R. 9 E.

Peat Resources

At present there are no commercial peat operations in DuPage County. Peat deposits do occur within the county and areas of peat are mapped on plate 1 as the Grayslake Peat (gl). Economic deposits of peat are most likely to be present in areas mapped as Grayslake Peat (gl) where swamp or bog-like conditions still exist.

Clay Resources

At present there are no active commercial clay pits in DuPage County.

Clay resources which are suitable for the manufacture of Chicago common brick and structural or building tile are widespread in the county. Suitable geologic materials are the Yorkville Till (wy), the Wadsworth Till (ww) and the Carmi Member of the Equality Formation (ec). Distribution of these geologic materials in the county are mapped on plate 1.

Dolomite Resources

The bedrock of DuPage County, underlying the glacial drift, consists almost entirely of dolomites of Silurian age. (The only exception is a narrow strip of the underlying Maquoketa Shale Group in a buried east-west valley crossing, T. 40 N., R. 10 E., in the north-central part of the county.)

Although most of the Silurian strata in DuPage County are of a quality suitable for making most grades of construction aggregate, certain impure zones, containing excessive chert or silty or clayey beds, may be found throughout the Silurian interval. As a general rule, quarries are able to handle the lower-quality intervals by blending them with stone from the better benches, thus achieving a quarry product that meets the necessary specifications. However, a small quarry, excavating only a limited thickness of stone, may have difficulty with the impure intervals because of an insufficient supply of high-purity stone above or below the impure interval. Also, local increases in the amount of impurities in any one interval or in the thickness of the impure interval(s) may make any particular location unfavorable for quarrying. Crushed stone is produced from one quarry in the county, that of Elmhurst Chicago Stone Co. at Elmhurst in the NW¼ Section 2 and the NE¼ Section 3, T. 39 N., R. 11 E. Production capacity is rated at 1500 tons per day (Bull. 23, Illinois Division of Highways), making it a moderate-size quarry. Abandoned crushed-stone quarries are known in two areas; one quarry is just south of Elmhurst in the SW¼ Section 24, T. 39 N., R. 11 E., and several are in the Naperville

area along the DuPage River. Several old building stone quarries are along the north bluff or the Des Plaines River within what is now the Argonne National Laboratory Reservation.

The chief constraint on stone production in DuPage County (aside from availability of property) is the rather thick cover of glacial drift. There is no generally recognized figure for maximum amounts of overburden that a quarry can economically handle, but for purposes of planning, 50 feet (16 meters) would seem to be a reasonable maximum. Therefore, areas of potential stone production may be defined as those with less than 50 feet (16 meters) of overburden. Such areas are shown on the accompanying page-size map, reproduced from Zeizel et al., 1962a. Although all areas with less than 50 feet (16 meters) of overburden may be deemed "potentially quarryable," any site being considered for quarry development should be test drilled to determine the quality of the stone available.

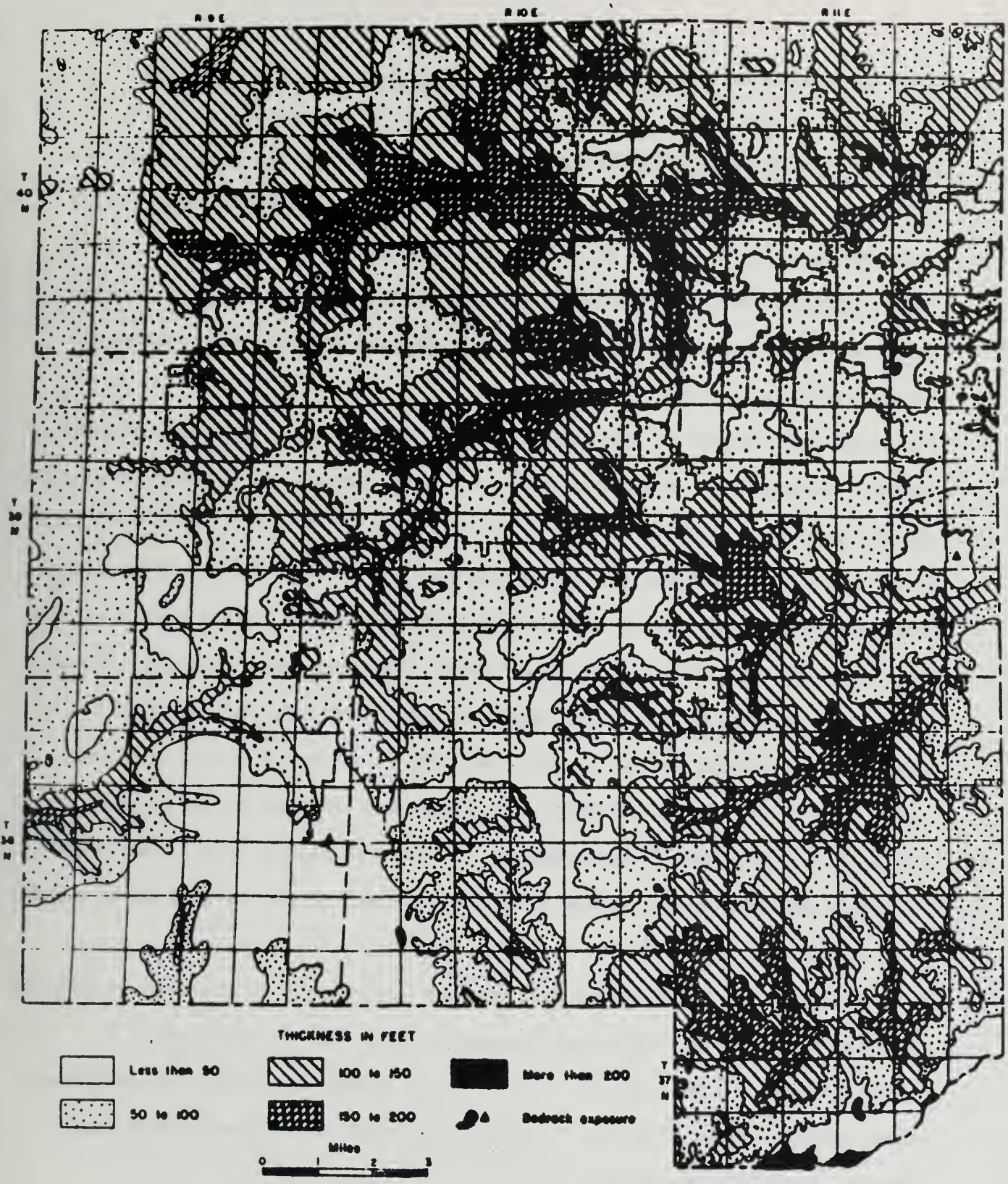

Figure 1. Map of DuPage County showing thickness of unconsolidated surficial deposits over bedrock. (adapted from Zeizel et al., 1962, Fig. 9)

SITES OF GEOLOGIC INTEREST

1. Herricks Lake Forest Preserve (Sec. 30 and 31, T. 39 N., R. 10 E.), Spring Lake (Sec. 2, T. 39 N., R. 9 E.) and the lakes in Pratts Wayne Woods Forest Preserve (Sec. 7, T. 40 N., R. 9 E.) are examples of ice-block lakes. These lakes occupy natural depressions formed by the melting of large ice blocks which became detached from the downwasting glacier and partially buried in the surrounding geologic materials.
2. Peat bogs have formed at numerous locations in the county in poorly drained natural depressions. A good example of a large peat bog is located in Section 28, T. 39 N., R. 9 E.
3. A prominent physiographic feature in the western part of the county is the West Chicago Moraine. This north-south ridge was formed at the margin of the glacier which deposited the Wadsworth Till. Sediment laden meltwater flowing away from the glacier formed the sand and gravel outwash plain west of the moraine. The DuPage County Airport (Sec. 29, T. 40 N., R. 9 E.) is a good location for viewing the moraine. The airport is located on the outwash plain at an elevation of approximately 750 feet above sea level. Two miles eastward the land surface rises 60 feet to the top of the moraine at an elevation of 810 feet (Sec. 27, T. 40 N., R. 9 E.).
4. Good exposures of Silurian dolomite bedrock are present in quarries at Elmhurst (Sec. 2, T. 39 N., R. 11 E.) and Naperville (Sec. 13, T. 38 N., R. 9 E.). The dolomite bedrock also outcrops in the valley of the West Branch of the DuPage River south of Naperville and in the Des Plaines River Valley in the southeastern corner of the county.
5. A prominent man-made physiographic feature in the vicinity of Warrenville is Mount Hoy, a mound of municipal refuse in an engineered sanitary landfill

(Sec. 26, T. 39 N., R. 9 E.). Mount Hoy is located in a sand and gravel pit which is now designated as a forest preserve. The mound of refuse is used for winter sports recreation. Mount Hoy is an example of the practice of the concept of multiple land use.

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